3.0 PRIORITIZATION OF BASINS BY AGGREGATES OF CRITERIA

As the final element of the basin prioritization effort, the tertiary basins were prioritized according to aggregates of the individual criteria. This process identified the basins which are expected to contribute the highest levels of excess freshwater and pollutant loads to the estuary. The basins were first aggregated according to three groups of important criteria representing the potential for excessive freshwater discharge, TSS loads, and nutrient loads. Each tertiary basin was then assigned an overall rank based on these three important types of potential impacts to the estuary. Lastly, the top 25% of the basins in terms of this overall rank were identified in order to provide a focus for the development of basin specific management actions to minimize the three types of impacts.

3.1 Prioritization by Three Important Classes of Impacts

As the first step of assigning overall ranks to the tertiary basins, the prioritization results for the individual criteria were summarized by ranking the tertiary basins according to three important classes of impacts. The District identified the three priority classes of impacts for this effort as:

- excessive freshwater discharge,
- TSS loads, and
- nutrient loads.

Each of these classes of impacts is being addressed by the District in the overall management of the estuary.

The ranks for the three important classes of criteria were assigned by combining the freshwater and pollutant load estimates developed for the individual criteria and re-ranking the basins with respect to these aggregated estimates.

- Total runoff discharge was computed as the sum of the estimated absolute agricultural runoff discharge and urban runoff discharge, and
- Nutrient loading priorities were computed as the arithmetic mean of the TN load rank and the TP load rank.

The TSS loading rank was the same as that discussed above. The tertiary basins were then re-ranked according to each of these combined indices of impact, as described in the following sections.

- Total Runoff Discharge

Runoff discharges from urban and agricultural land uses (non-area-weighted: Figures 2-1 and 2-3, respectively; area-weighted: Figures 2-2 and 2-4, respectively) were combined to determine the relative ranking of tertiary basins with respect to total runoff discharge. This analysis resulted in the priority basins presented in Table 3-1; Table 3-2 presents the area-weighted relative ranks for total runoff discharge. Figure 3-1 presents the results of the total runoff discharge ranking of the 62 tertiary basins in the study area grouped as described previously into high, medium, and low impact basins. Figure 3-2 presents the area-weighted results of the total runoff discharge ranking of the 62 tertiary basins in the study area.

The top ranked tertiary basins in the Estero Bay Watershed for total runoff discharge include three basins located in the eastern portion of the watershed that are larger than 18,000 acres in area, and have more that 20% of their land use in agricultural uses. These basins include TB 6 in the Imperial River Basin, TB 8 in the Estero River Basin, and TB 4 in the Six-Mile Cypress Slough Basin.

Of the priority basins with respect to total runoff discharge, 14 are also priority basins with respect to urban runoff discharge, ten are also priority basins with respect to agricultural runoff discharge, and eight are priority basins with respect to both urban runoff discharge and agricultural runoff discharge.

Table 3-1. Relative ranks of the top 25% of the tertiary basins within the Estero Bay Watershed for total runoff discharge.

Secondary Basin	Tertiary Basin	Area (acres)	% Urban Land Use	% Agricultural Land Use	Urban+Agricultural Runoff (acre-feet/yr)	Rank
Estero River	8	27647	16	27	18373	1
Imperial River	6	41568	3	25	17163	2
Six-Mile Cypress Slough	4	18354	20	23	12483	3
Mullock Creek	4	3596	81	7	6418	4
Six-Mile Cypress Slough	1	8345	29	15	5428	5
Imperial River	4	4695	30	37	4882	6
Imperial River	1	3464	61	0	4421	7
Barrier Islands	1	15726	13	0	4311	8
Estero River	6	7467	15	27	4263	9
Hendry Creek	10	2459	59	0	3769	10
Six-Mile Cypress Slough	3	3893	42	13	3073	11
Ten-Mile Canal	11	2569	42	12	2762	12
Cow Creek	2	1864	61	0	2444	13

Table 3-1.	**Relative ranks of the top 25% of the tertiary basins within the Estero Bay Watershed for total runoff discharge.**					
Imperial River	3	1988	58	7	2099	14
Estero River	5	2460	41	17	1935	15
Ten-Mile Canal	6	1728	44	28	1884	16

The area-weighted rankings of the tertiary basins within the Estero Bay Watershed show that the top-ranked tertiary basin is TB 6 in the Hendry Creek Basin. Two other tertiary basins in the Hendry Creek Basin are in the top five high priority basins with respect to total runoff discharge. The second-ranked tertiary basin is TB 4 in the Mullock Creek Basin, and the third-ranked is TB 4 in the Ten-Mile Canal Basin.

Table 3-2. Relative ranks of the top 25% of the tertiary basins within the Estero Bay Watershed for area-weighted total runoff discharge.

Secondary Basin	Tertiary Basin	Area (acres)	% Urban Land Use	% Agricultural Land Use	Area-weighted Urban+Agricultural Runoff (acre-feet/yr)/acre	Rank
Hendry Creek	6	449	63	7	1.85036	1
Mullock Creek	4	3596	81	7	1.78481	2
Ten-Mile Canal	4	153	67	0	1.63033	3
Hendry Creek	10	2459	59	0	1.53293	4
Hendry Creek	9	517	67	0	1.47858	5
Ten-Mile Canal	1	129	67	0	1.40605	6
Hendry Creek	8	863	66	7	1.37921	7
Ten-Mile Canal	9	1266	53	24	1.35829	8
Cow Creek	2	1864	61	0	1.31085	9
Imperial River	1	3464	61	0	1.2763	10
Estero River	4	124	64	0	1.23072	11
Cow Creek	4	132	74	0	1.16561	12
Ten-Mile Canal	6	1728	44	28	1.09036	13
Ten-Mile Canal	11	2569	42	12	1.07532	14
Ten-Mile Canal	7	404	47	0	1.06851	15
Imperial River	3	1988	58	7	1.05586	16

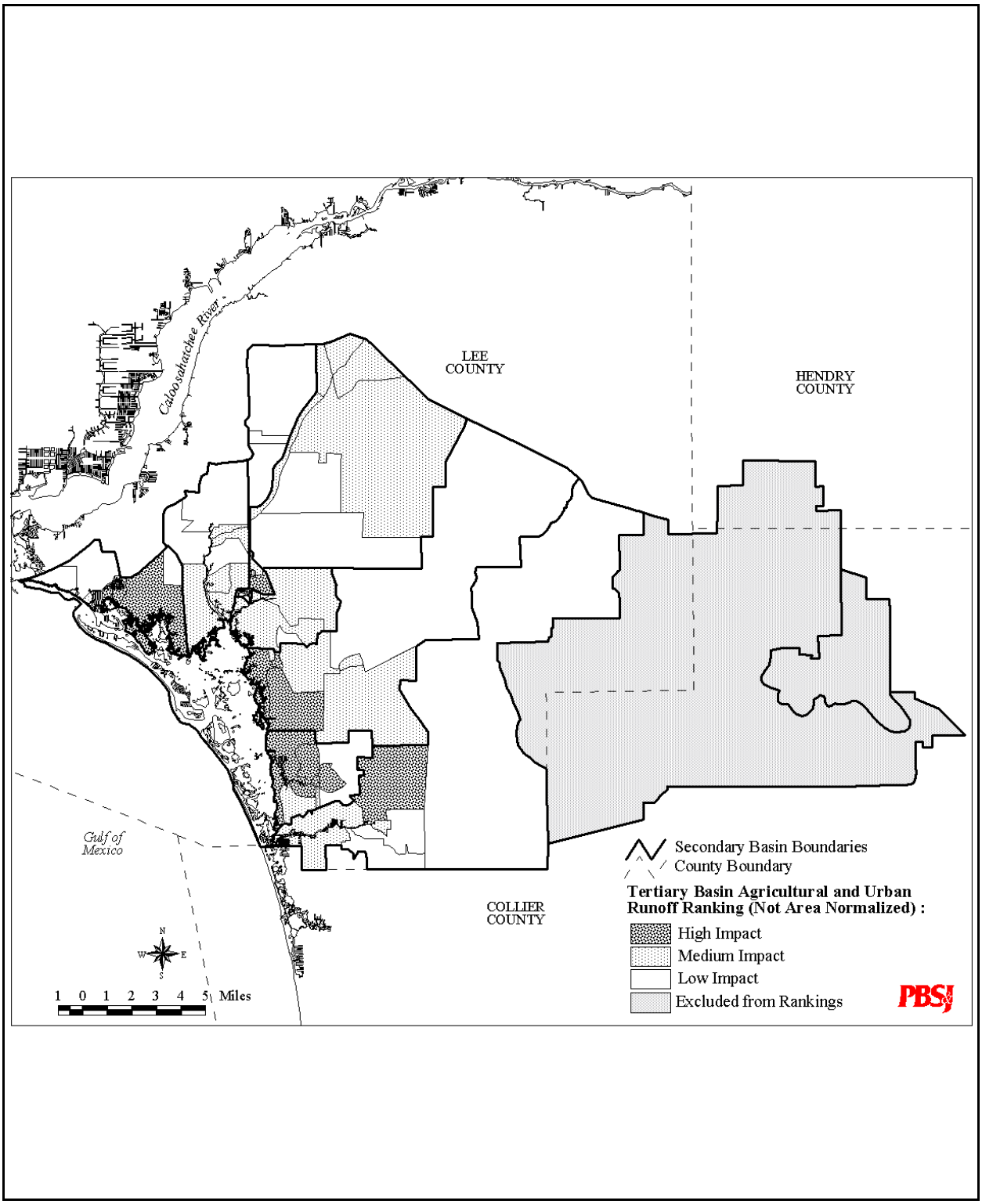

Figure 3-1. Tertiary basins classified by total runoff discharge.

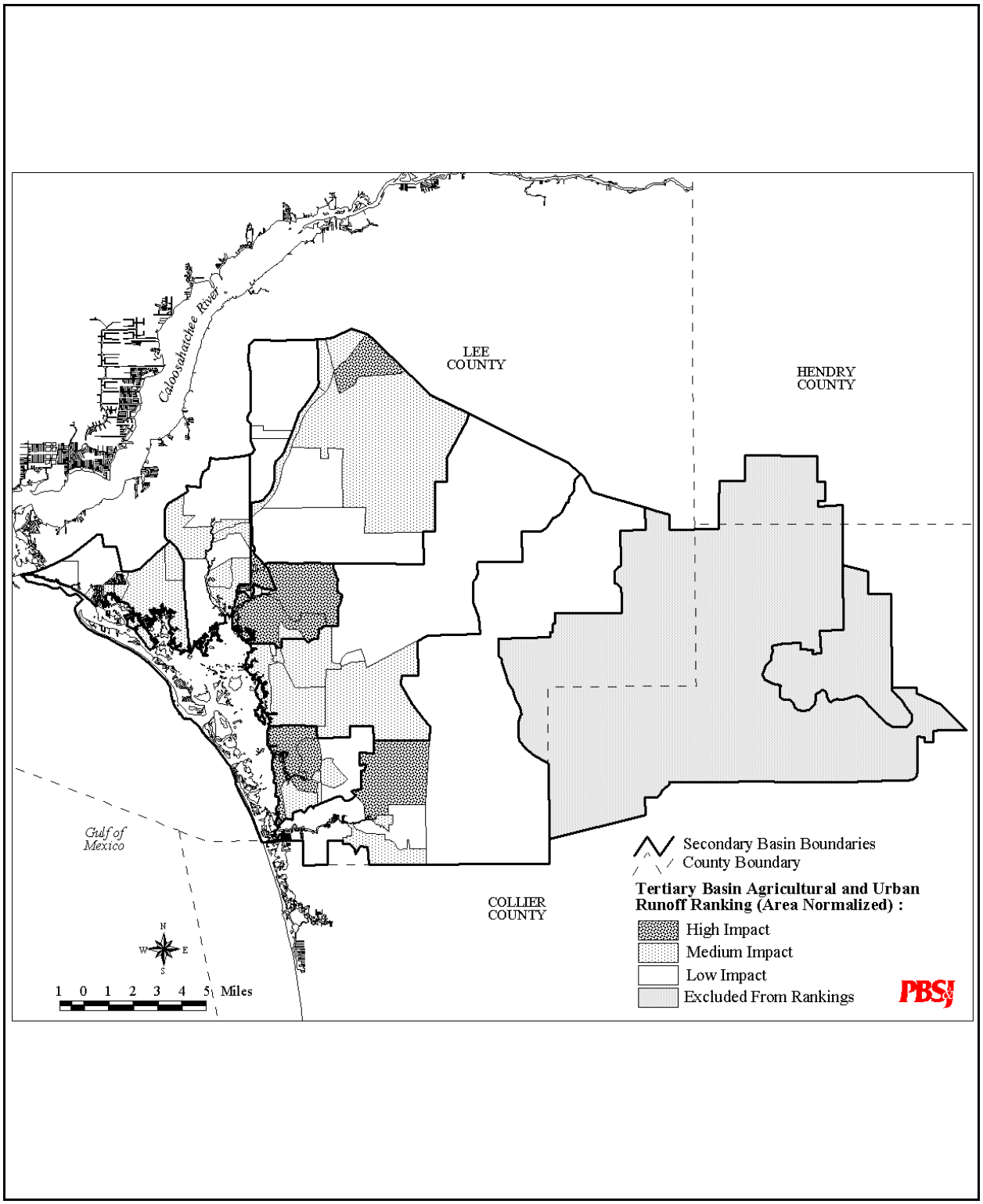

Figure 3-2. Tertiary basins classified by area-weighted total runoff discharge.

- TSS Loading

TSS loading is discussed in Section 2.3, with the locations of the priority basins shown in Figures 2-5 (non-area-weighted) and 2-6 (area-weighted) and the relative rankings for the priority basins given in Tables 2-5 (non-area-weighted) and 2-6 (area-weighted).

- TN and TP Loading

TN and TP loadings from urban and agricultural land uses (non-area-weighted: Figures 2-7 and 2-9, respectively; area-weighted: Figures 2-8 and 2-10, respectively) were combined to determine the relative ranking of tertiary basins with respect to total nutrient loading. This analysis resulted in the priority basins presented in Table 3-3; Table 3-4 presents the area-weighted relative ranks for total runoff discharge. Figure 3-3 presents the results of the total nutrient load ranking of the 62 tertiary basins in the study area grouped as described previously into high, medium, and low impact basins. Figure 3-4 presents the area-weighted results of the total nutrient load ranking of the 62 tertiary basins in the study area.

The top ranked tertiary basins in the Estero Bay Watershed for total runoff discharge include the three basins located in the eastern portion of the watershed that are larger than 18,000 acres in area, and have more that 20% of their land use in agricultural uses. These basins include TB 6 in the Imperial River Basin, TB 8 in the Estero River Basin, and TB 4 in the Six-Mile Cypress Slough Basin.

The priority basins with respect to total nutrient loading are, as expected, very similar to those with respect to total annual nitrogen loading and total annual phosphorus loading. All of the priority basins are the same for total nutrient loading and total annual phosphorus loading, and 15 of the 16 are the same for total nutrient loading and total annual nitrogen loading.

Table 3-3. Relative ranks of the top 25% of the tertiary basins within the Estero Bay Watershed for total nutrient loading.

Secondary Basin	Tertiary Basin (TB)	Area (acres)	% Urban Land Use	% Agricultural Land Use	Urban + Agricultural Runoff (acre-feet/yr)	TN + TP Load Rank
Imperial River	6	41568	3	25	17163	1.00
Estero River	8	27647	16	27	18373	2.00
Six-Mile Cypress Slough	4	18354	20	23	12483	3.00
Six-Mile Cypress Slough	1	8345	29	15	5428	4.00
Imperial River	4	4695	30	37	4882	5.00
Estero River	6	7467	15	27	4263	6.50
Mullock Creek	4	3596	81	7	6418	7.50
Six-Mile Cypress Slough	3	3893	42	13	3073	8.50
Ten-Mile Canal	11	2569	42	12	2762	8.50
Imperial River	1	3464	61	0	4421	9.00
Hendry Creek	10	2459	59	0	3769	12.00
Estero River	5	2460	41	17	1935	12.50
Barrier Islands	1	15726	13	0	4311	13.00
Hendry Creek	5	1874	27	29	1388	14.00
Spring Creek	7	2482	36	10	1812	14.50
Estero River	3	2699	14	15	1094	15.50

The area-weighted rankings of the tertiary basins within the Estero Bay Watershed show that the top-ranked tertiary basin is TB 11 in the Ten-Mile Canal Basin. Four other tertiary basins in the Ten-Mile Canal Basin are high priority basins with respect to area-weighted total nutrient discharge. The second-ranked tertiary basin is TB 6 in the Spring Creek Basin, and the third-ranked is TB 5 in the Six-Mile Cypress Slough Basin.

Table 3-4. Relative ranks of the top 25% of the tertiary basins within the Estero Bay Watershed for area-weighted total nutrient loading.

Secondary Basin	Tertiary Basin (TB)	Area (acres)	% Urban Land Use	% Agricultural Land Use	Area-weighted TN + TP Load Rank	
Ten-Mile Canal	11	2569	42	12	1.5	
Spring Creek	6	545	40	0	4.5	
Six-Mile Cypress Slough	5	653	14	29	7.0	
Mullock Creek	5	290	53	0	7.5	
Hendry Creek	8	863	66	7	7.5	
Imperial River	4	4695	30	37	8.0	
Hendry Creek	5	1874	27	29	10.5	
Hendry Creek	10	2459	59	0	10.5	
Mullock Creek	4	3596	81	7	12.0	
Ten-Mile Canal	8	1441	11	42	14.0	
Hendry Creek	9	517	67	0	14.5	
Ten-Mile Canal	9	1266	53	24	17.0	
Estero River	5	2460	41	17	18.0	
Imperial River	2	1738	49	2	18.5	
Ten-Mile Canal	4	153	67	0	18.5	
Ten-Mile Canal	6	1728	44	28	18.5	

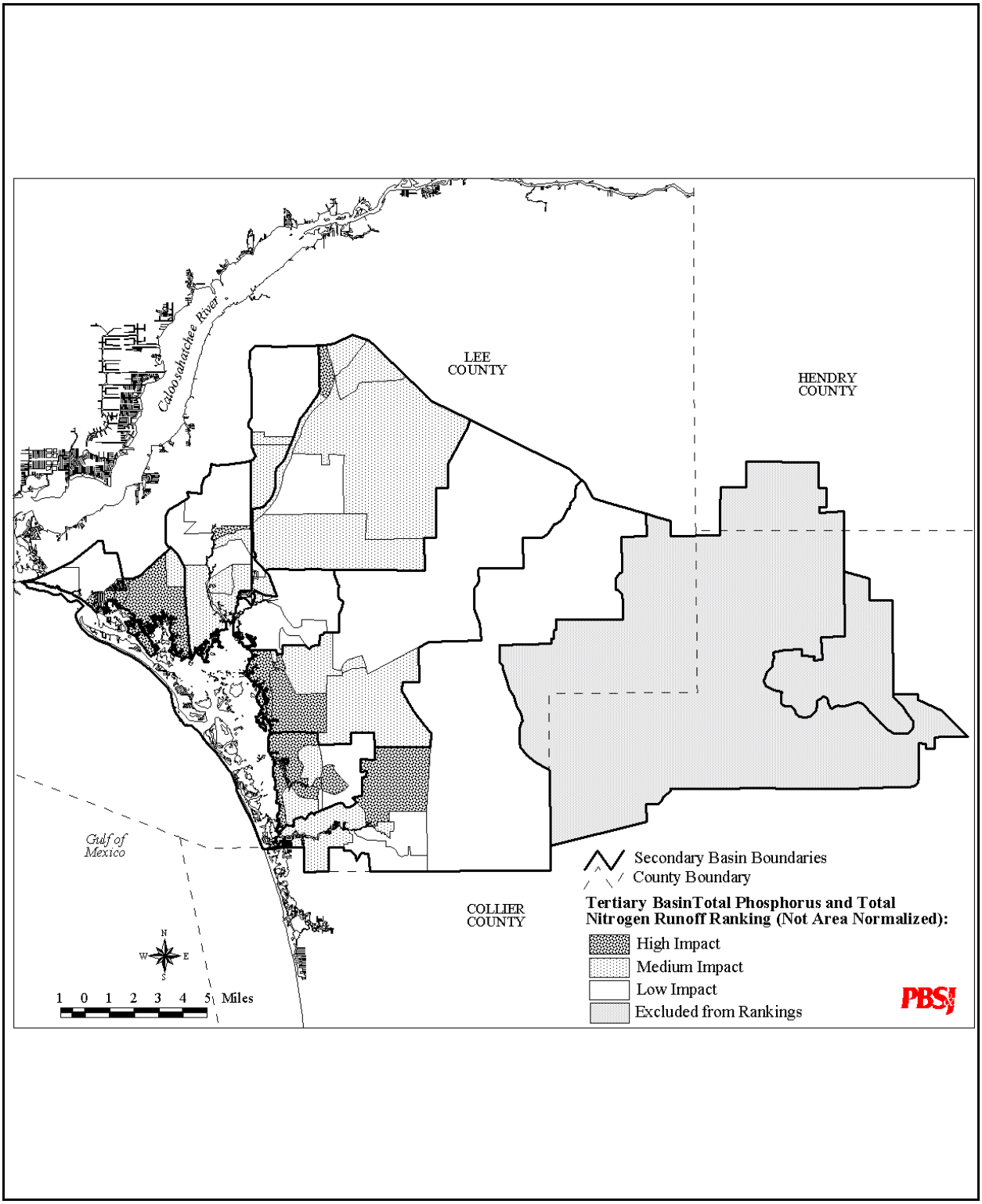

Figure 3-3. Tertiary basins classified by total nutrient loading.

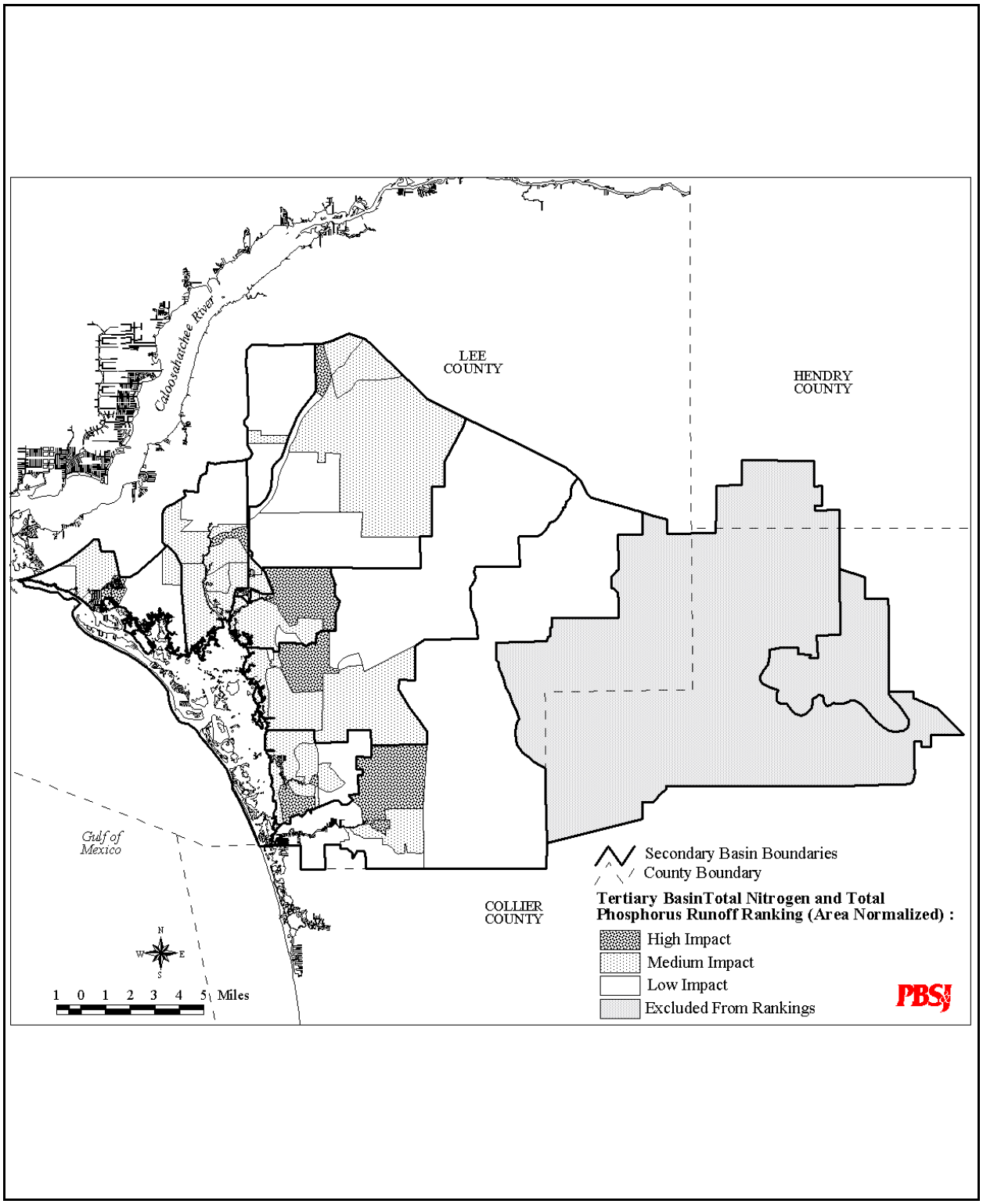

Figure 3-4. Tertiary basins classified by area-weighted total nutrient loading.

3.2 Overall Prioritization

For the final step in the overall basin prioritization, each tertiary basin was assigned an overall rank based on the three classes of impacts. The objective of this overall ranking was to identify the top 25% of tertiary basins in the study area with respect to the three important classes of impacts. Management options are currently being developed for each of these priority basins, and are the subject of the next volume in this report series.

The three classes of impacts are correlated, and they can be attributed to particular anthropogenic activities within the watershed. Excessive freshwater runoff, sediment loads, and nutrient loads all are exacerbated by the creation of impervious surfaces, draining of wetlands, channelization, and clearing of forest and wetland vegetation. As discussed in the previous sections, the tertiary basins having the highest runoff discharges are also likely to have the highest sediment and nutrient loads. These criteria are not independent, as nutrient and sediment loads are functions of freshwater runoff, but have been treated in this analysis individually to allow management decisions to be made on the basis of individual criteria.

Although the geographic distributions of the three classes of impacts are similar and correlated, they respond differently to specific land use practices. Land use-specific sediment loading rates vary independently from runoff rates according to the degree of soil disturbance from tillage, livestock compacting of soils, removal of vegetative cover, and other factors. Land use-specific nutrient loading rates vary independently from runoff rates according to the degree of grove and cropland fertilization, animal waste production, lawn care and horticulture fertilization, and other factors. Nutrient loading rates for nitrogen and phosphorus are dependent upon land uses, and do not vary by the same amount due to land use variation. This accounts for the differences in the priority tertiary basins based on the nitrogen and phosphorus loading criteria.

Because the three classes of impacts vary by land use, one can not objectively state whether a particular basin is a higher priority than another without assigning a set of specific numeric levels of importance to each class of impact. For this project, there were two options for assigning levels of importance to the three classes. The first option was to assign a numeric weight to each of the three classes, and the second option was to assign equal weights to each of the three classes. The advantage of the first option was that it would allow information on the relative level of importance of the three classes of impacts to be used directly in identifying the top 25% of priority basins. The District was able to identify the most important impact as excess freshwater runoff discharge, the next most important impact as TSS loads, and the least important of the three impacts as nutrient loads. The disadvantage of assigning numeric weights was that a specific value of the importance of each of the three classes would have to be assigned, and there was not an objective method of identifying these values or weights. The advantage of the second option of assigning equal weights was that it precluded the possibility of assigning too much importance to a particular class of impact. For example, assigning too high of a weight to freshwater runoff discharge might result in missing

specific tertiary basins where concentrations of nutrients could be efficiently treated. The disadvantage of the second option of assigning equal weights was that the District's useful subjective knowledge about the order of importance of the classes of impacts would not be directly applied.

Given the lack of a method of assigning weights to the classes of impacts, equal weights were assigned to each of the three important classes of impacts. This analysis was applied to the tertiary basins of the study area for a three dimensional model of freshwater runoff discharge, TSS loads, and nutrient loads, with the overall rank calculated as the mean of the ranks of the three criteria. The results of this analysis are presented in Table 3-3 for the non-area-weighted overall ranking, and in Table 3-4 for the area-weighted overall ranking. The tertiary basins within this top 25% group are the highest priority tertiary basins within the Estero Bay Watershed.

The top ranked tertiary basins in the Estero Bay Watershed for overall rank include the three basins located in the eastern portion of the watershed that are larger than 18,000 acres in area, and have more that 20% of their land use in agricultural uses. These basins include TB 6 in the Imperial River Basin, TB 8 in the Estero River Basin, and TB 4 in the Six-Mile Cypress Slough Basin.

Of the 16 priority tertiary basins as determined by the overall rank, 14 are also priority basins with respect to total nutrient loading, 15 are priority basins with respect to total suspended solids loading, and 15 are priority basins with respect to total runoff discharge. Clearly, these priority basins represent the most important contributors of nutrient, suspended solids, and hydrologic load to the estuary.

Table 3-5. Relative ranks of the top 25% of the tertiary basins within the Estero Bay Watershed for overall rank.

Secondary Basin	Tertiary Basin	Area (acres)	Rank Total Runoff	Rank TN&TP Loading	Rank TSS Loading	Overall Rank
Imperial River	6	41568	2	1.00	1	1.33
Estero River	8	27647	1	2.00	2	1.67
Six-Mile Cypress Slough	4	18354	3	3.00	3	3.00
Six-Mile Cypress Slough	1	8345	5	4.00	4	4.33
Mullock Creek	4	3596	4	7.50	6	5.83
Imperial River	4	4695	6	5.00	10	7.00
Imperial River	1	3464	7	9.00	9	8.33
Hendry Creek	10	2459	10	12.00	5	9.00
Estero River	6	7467	9	6.50	12	9.17
Barrier Islands	1	15726	8	13.00	7	9.33
Ten-Mile Canal	11	2569	12	8.50	8	9.50
Six-Mile Cypress Slough	3	3893	11	8.50	11	10.17
Estero River	5	2460	15	12.50	15	14.17

Table 3-5.	**Relative ranks of the top 25% of the tertiary basins within the Estero Bay Watershed for overall rank.**					
Spring Creek	7	2482	17	14.50	13	14.83
Cow Creek	2	1864	13	22.00	14	16.33
Imperial River	3	1988	14	18.50	18	16.83

The area-weighted rankings of the tertiary basins within the Estero Bay Watershed show that the top-ranked tertiary basin is TB 10 in the Hendry Creek Basin. Three other tertiary basins in the Hendry Creek Basin are in the top six ranked tertiary basins for area-weighted overall priority, including TB 6, 8, and 9. TB 11 in the Ten-Mile Canal Basin is also within the top six ranked tertiary basin, as is TB 4 in the Mullock Creek Basin.

Table 3-6. Relative ranks of the top 25% of the tertiary basins within the Estero Bay Watershed for area-weighted overall rank.

Secondary Basin	Tertiary Basin	Area (acres)	Area-Weighted Total Runoff Rank	Area-Weighted TN&TP Loading Rank	Area-Weighted TSS Loading Rank	Area-Weighted Overall Rank
Hendry Creek	10	2459	4	10.5	2	5.50
Hendry Creek	8	863	7	7.5	5	6.50
Ten-Mile Canal	11	2569	14	1.5	4	6.50
Mullock Creek	4	3596	2	12.0	9	7.67
Hendry Creek	6	449	1	23.5	1	8.50
Hendry Creek	9	517	5	14.5	6	8.50
Ten-Mile Canal	4	153	3	18.5	8	9.83
Ten-Mile Canal	9	1266	8	17.0	11	12.00
Ten-Mile Canal	7	404	15	20.5	3	12.83
Imperial River	1	3464	10	22.5	13	15.17
Ten-Mile Canal	6	1728	13	18.5	17	16.17
Spring Creek	6	545	38	4.5	7	16.50
Mullock Creek	5	290	25	7.5	20	17.50
Six-Mile Cypress Slough	5	653	20	7.0	28	18.33
Cow Creek	2	1864	9	34.5	12	18.50
Imperial River	2	1738	24	18.5	15	19.17

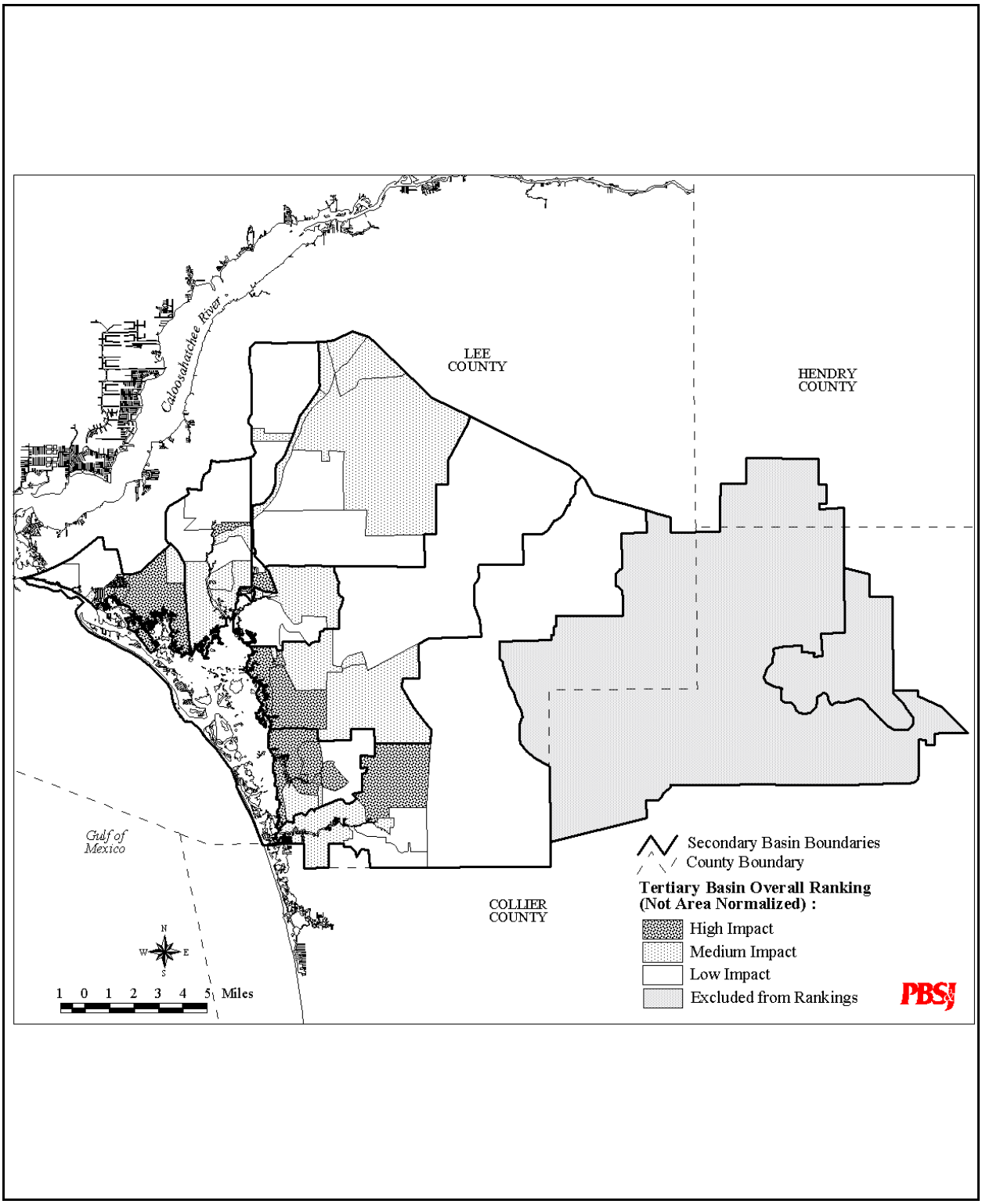

Figure 3-5. Tertiary basins classified by overall rank.

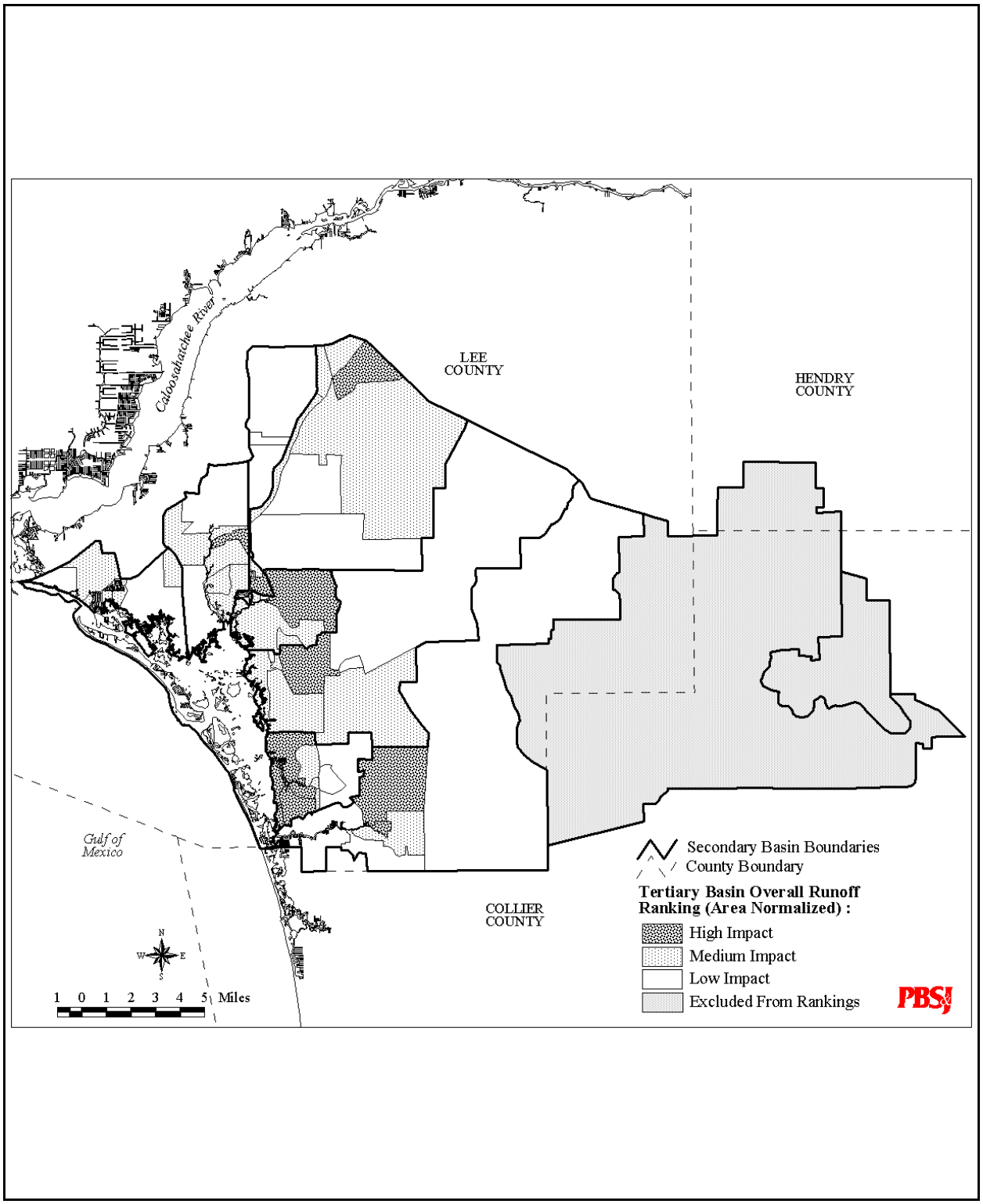

Figure 3-6. Tertiary basins classified by area-weighted overall rank.